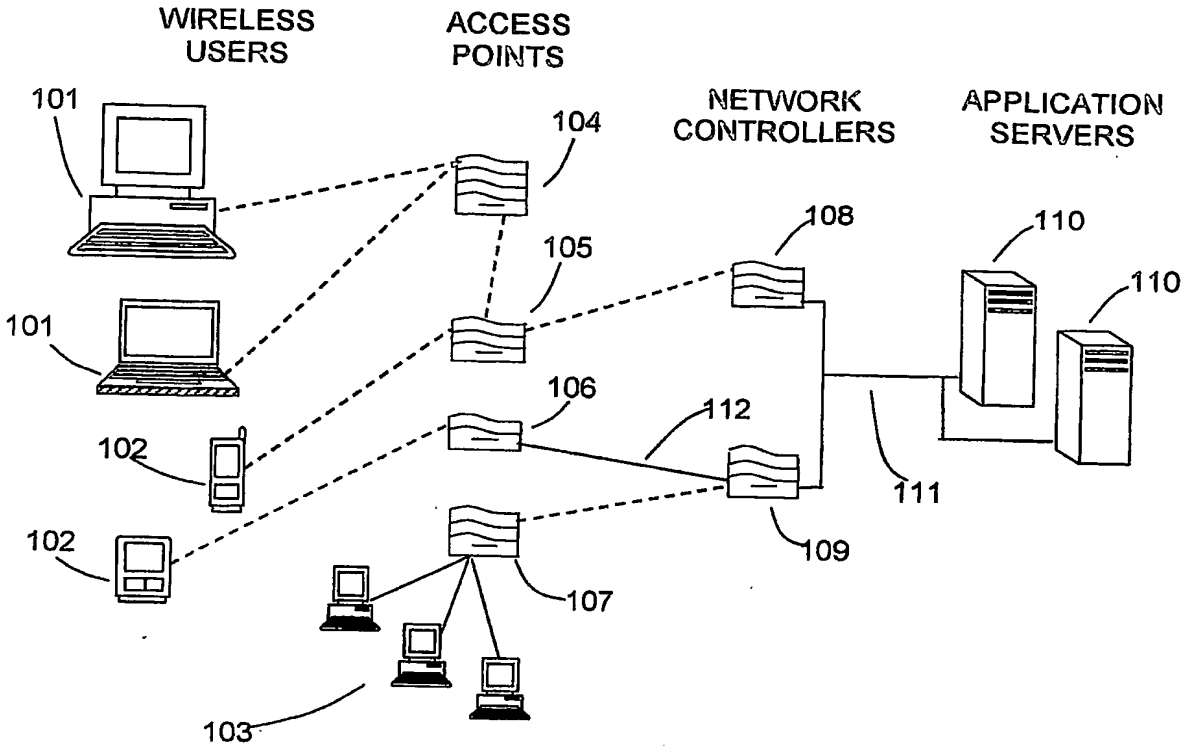


FIG.1A : WIRELESS LOCAL AREA NETWORK SYSTEM

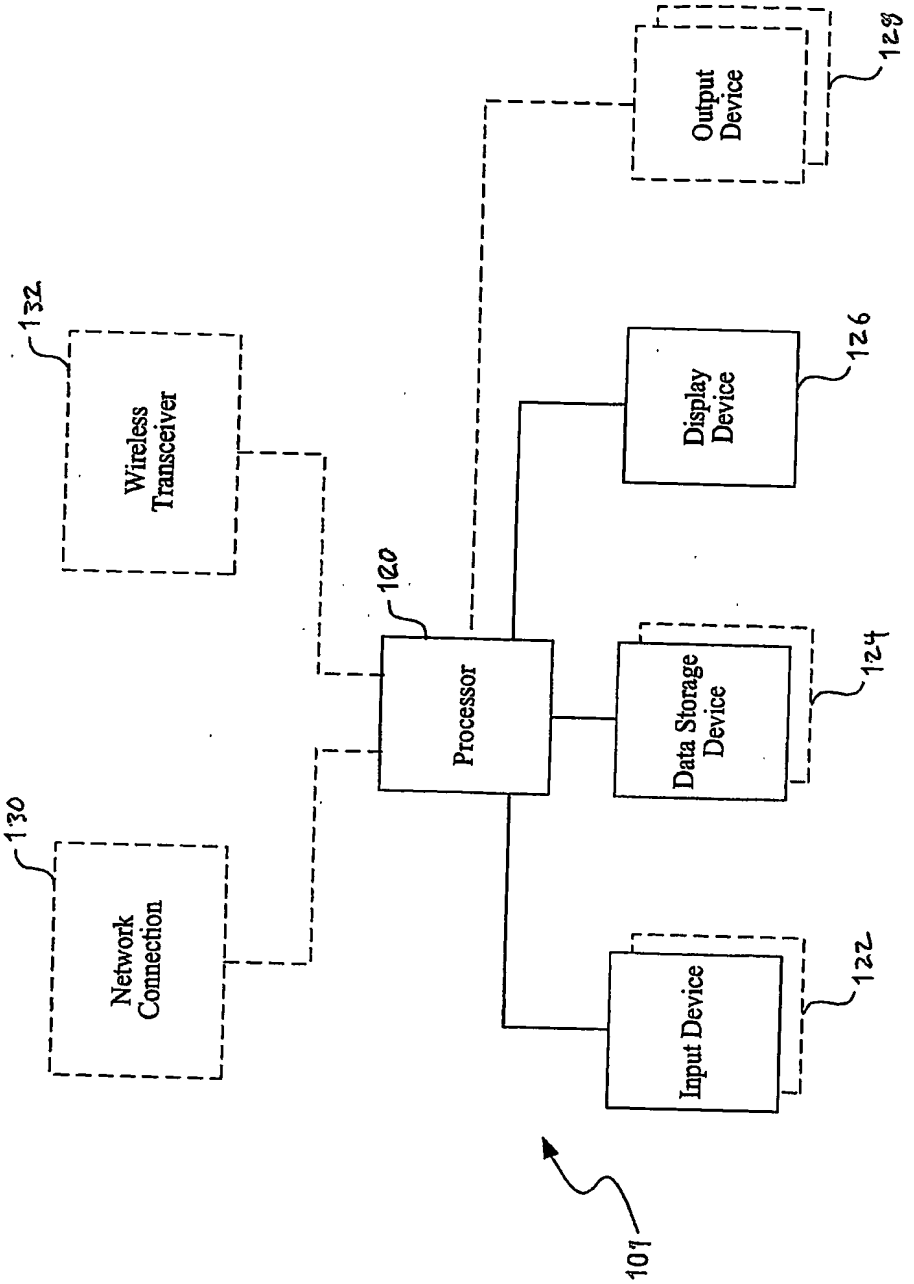

Output Device
128
Wireless Transceiver
132
Display Device
126
Processor
120
Data Storage Device
124
Network Connection
130
Input Device
122
101

Fig. 1B

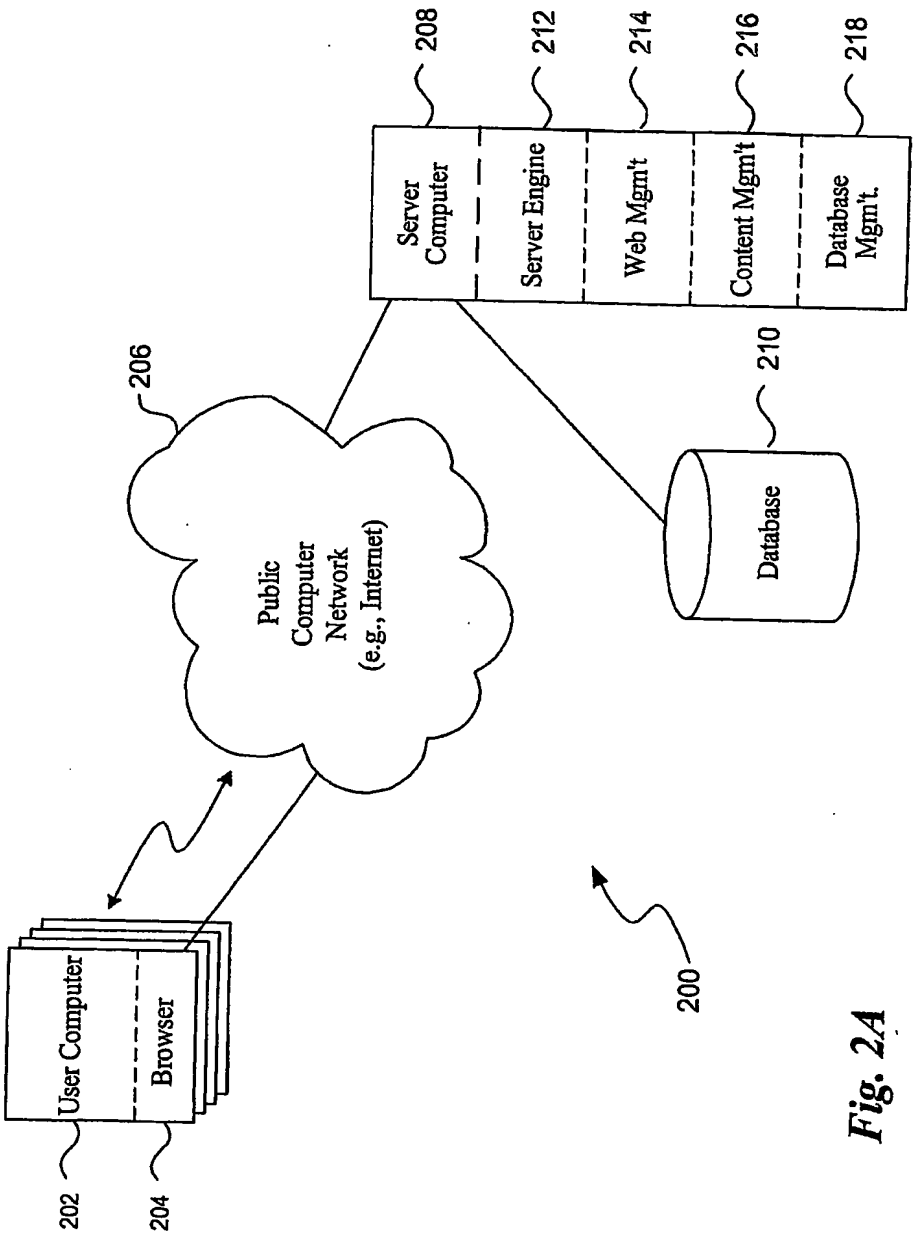

208
212
214
216
218
Server Computer
Server Engine
Web Mgm't
Content Mgm't
Database Mgm't.
206
210
Public Computer Network (e.g., Internet)
Database
User Computer
Browser
202
204
200

Fig. 2A

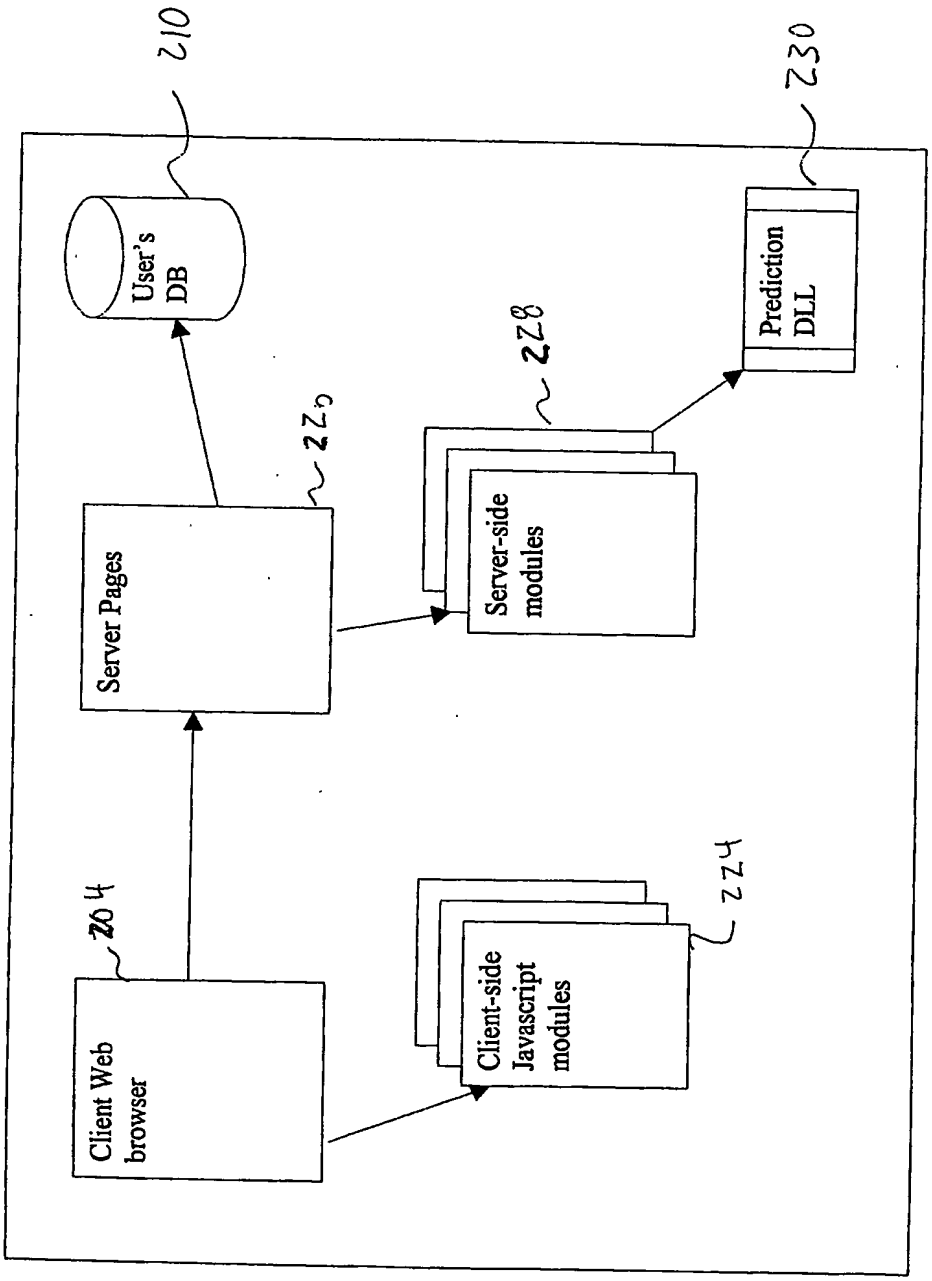


FIG. 2 CLIENT – SERVER APPLICATION BASIC ARCHITECTURE

Architect/One

Account | Projects | Logout

Create | Undo | Print

User: scott | bozo

Create New Project

Project name (*)

Project address ~302

Physical project environment

Building construction: metal frame ~304

Total project space: 10000 sq ft ~306

Number of floors occupied: 1 ~308

Is there a floor plan? Floor 1 (GIF, JPEG): Browse... ~310

Ceiling height: 8 ft ~312

Node placement preference: ○ none ○ desk ○ shelf ○ partitions ○ ceiling ◉ wall ~314

Desired wireless coverage

Number of users: 5 ~316

Throughput per user: 1 Mbps ~318

User coverage: ☐ 802.11a ☐ 802.11b ☐ 802.11g ☐ Bluetooth ~320

Antenna Type: omni directional ~322

Network Infrastructure: ◉ Wireless Infrastructure ○ Wired Infrastructure ~324

300

FIG 3

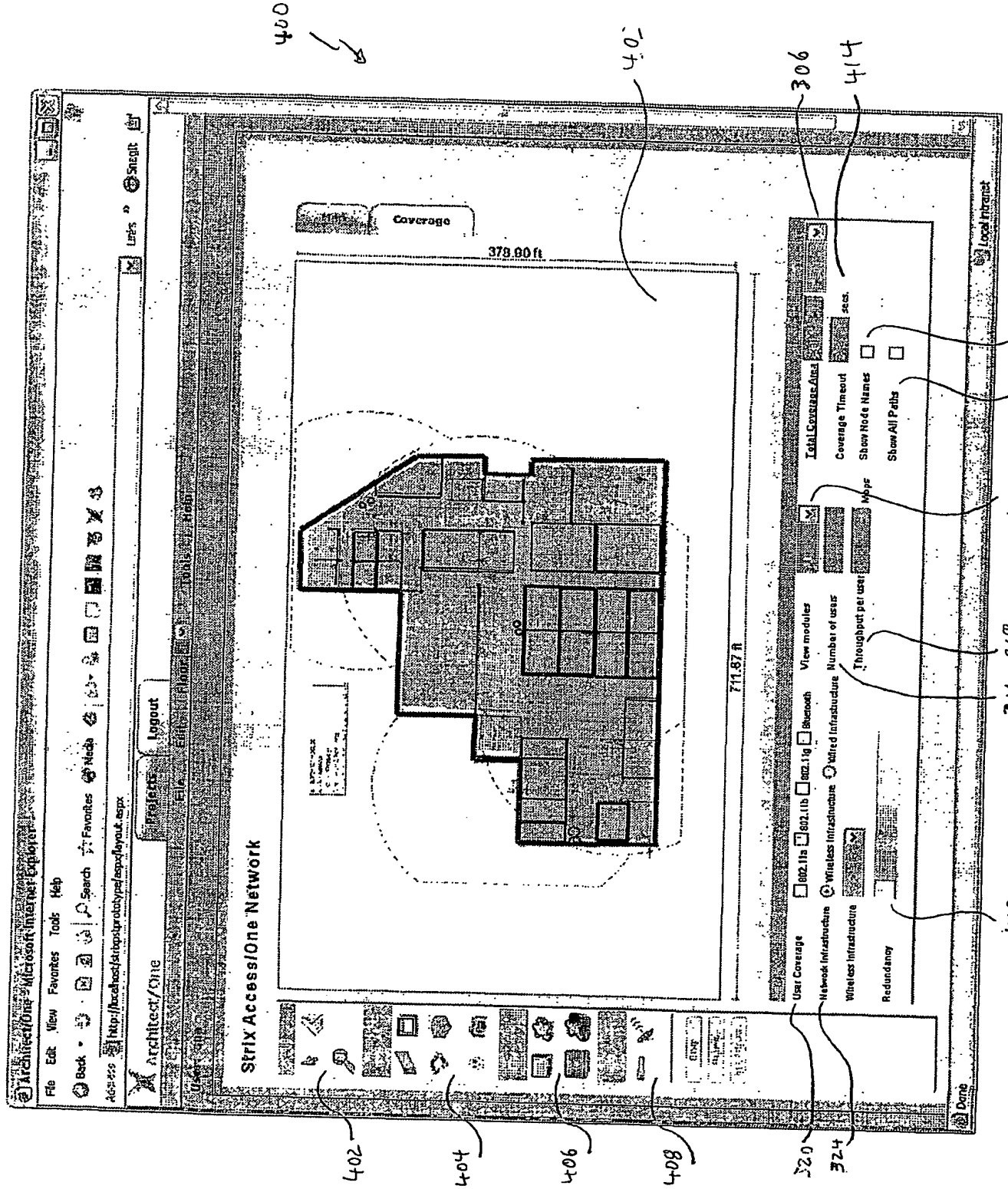

400
402
404
406
408
410
412
414
416
418
320
324
316
318
306
Strix Access/One Network
Coverage
378.00 ft
711.87 ft
Logout
Preferences
Total Coverage Area
Coverage Timeout
Show Node Names
Show All Paths
Maps
View modules
Number of users
Throughput per user
User Coverage
Network Infrastructure
Wireless Infrastructure
Redundancy
802.11a
802.11b
802.11g
Bluetooth
Wireless Infrastructure
Wired Infrastructure
Local Intranet
Done

FIG. 4A

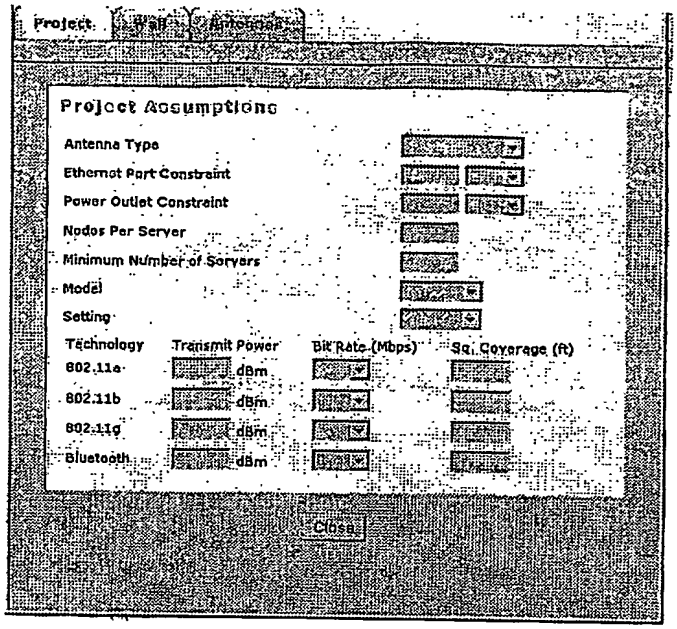

Project
Wall
Antennas
Project Assumptions
Antenna Type
Ethernet Port Constraint
Power Outlet Constraint
Nodes Per Server
Minimum Number of Servers
Model
Setting
Technology
Transmit Power
Bit Rate (Mbps)
Sq. Coverage (ft)
802.11a
dBm
802.11b
dBm
802.11g
dBm
Bluetooth
dBm
Close

FIG 4B

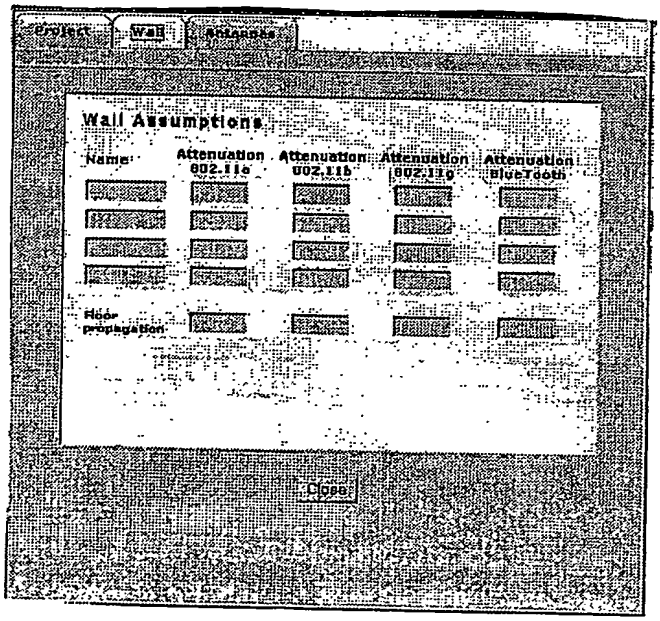

Project
Wall
Antennas
Wall Assumptions
Name
Attenuation 802.11a
Attenuation 802.11b
Attenuation 802.11g
Attenuation Bluetooth
Floor propagation
Close

FIG 4C

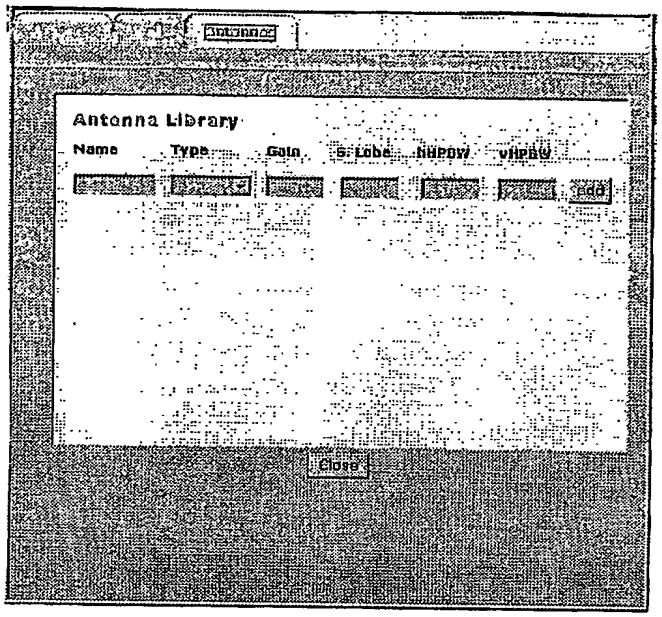

Antenna
Antenna Library
Name
Type
Gain
3 Lobe
HHPBW
VHPBW
Add
Close

FIG 4D

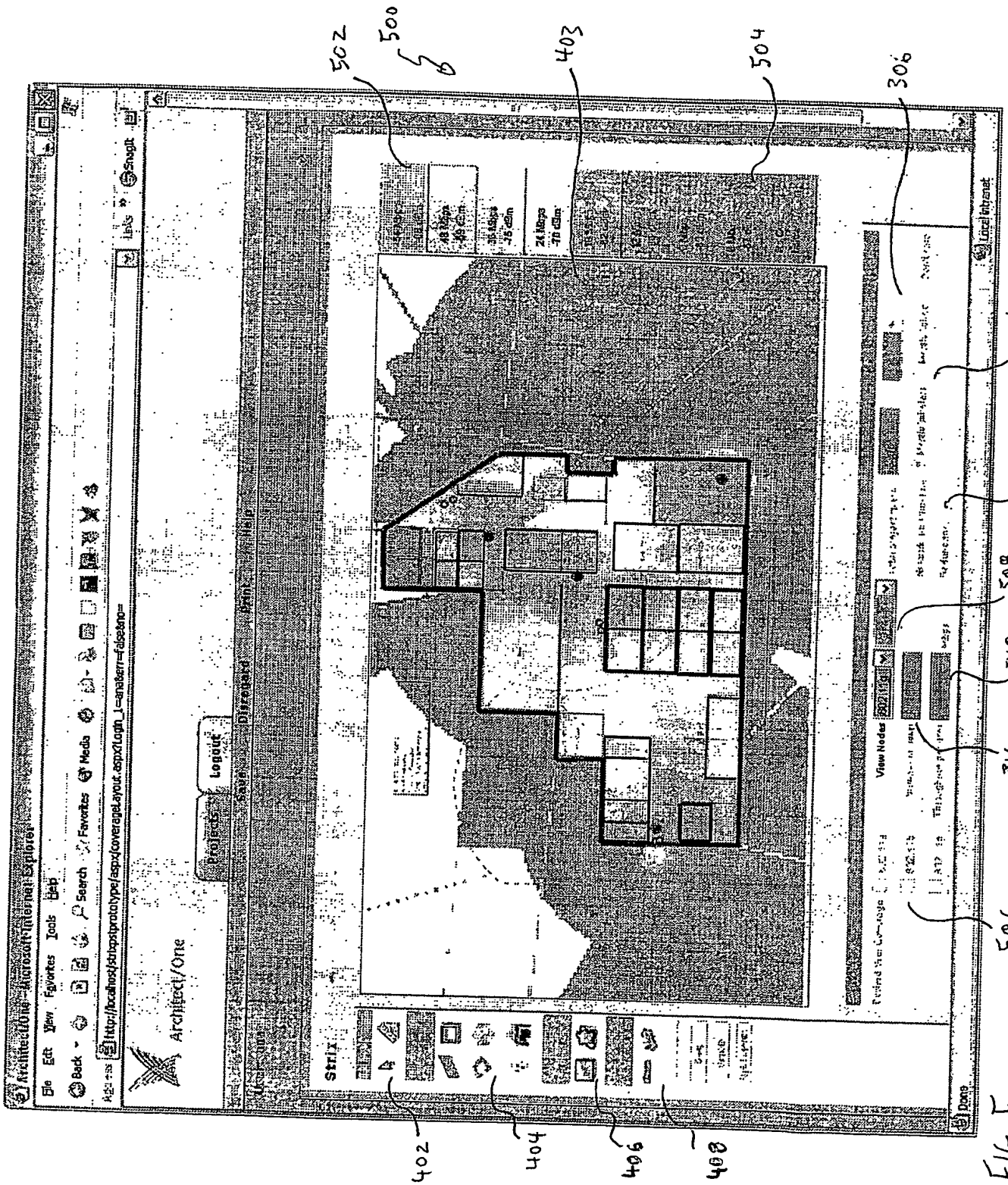

502
500
403
504
306
324
410
508
318
316
506
402
404
406
408
Architect/One
Logout
Projects
Save
Directory
Help
Strix
View Nodes
Local intranet
Done

FIG. 5

Inventory by Node 602

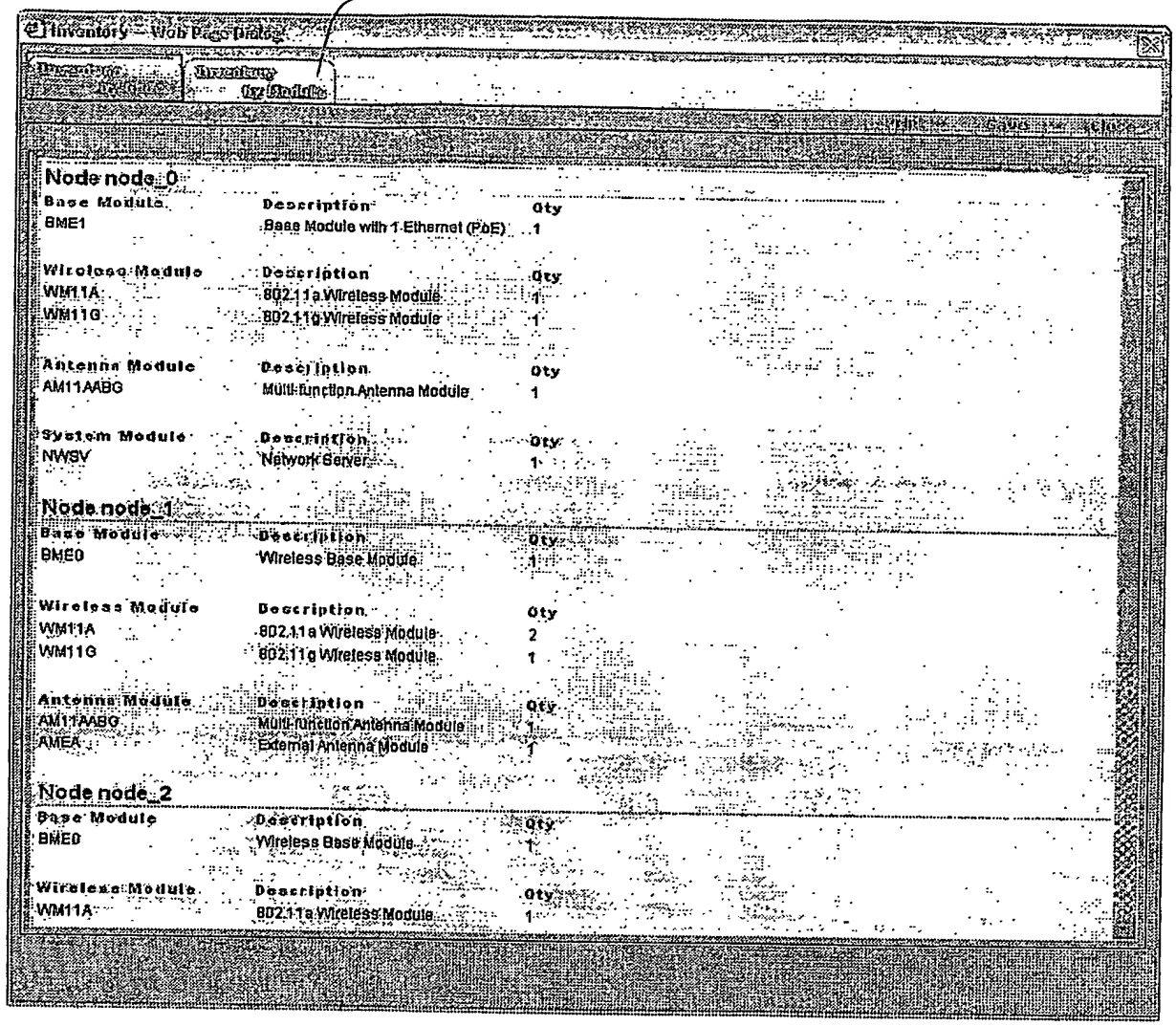


FIG. 6

Inventory by Module

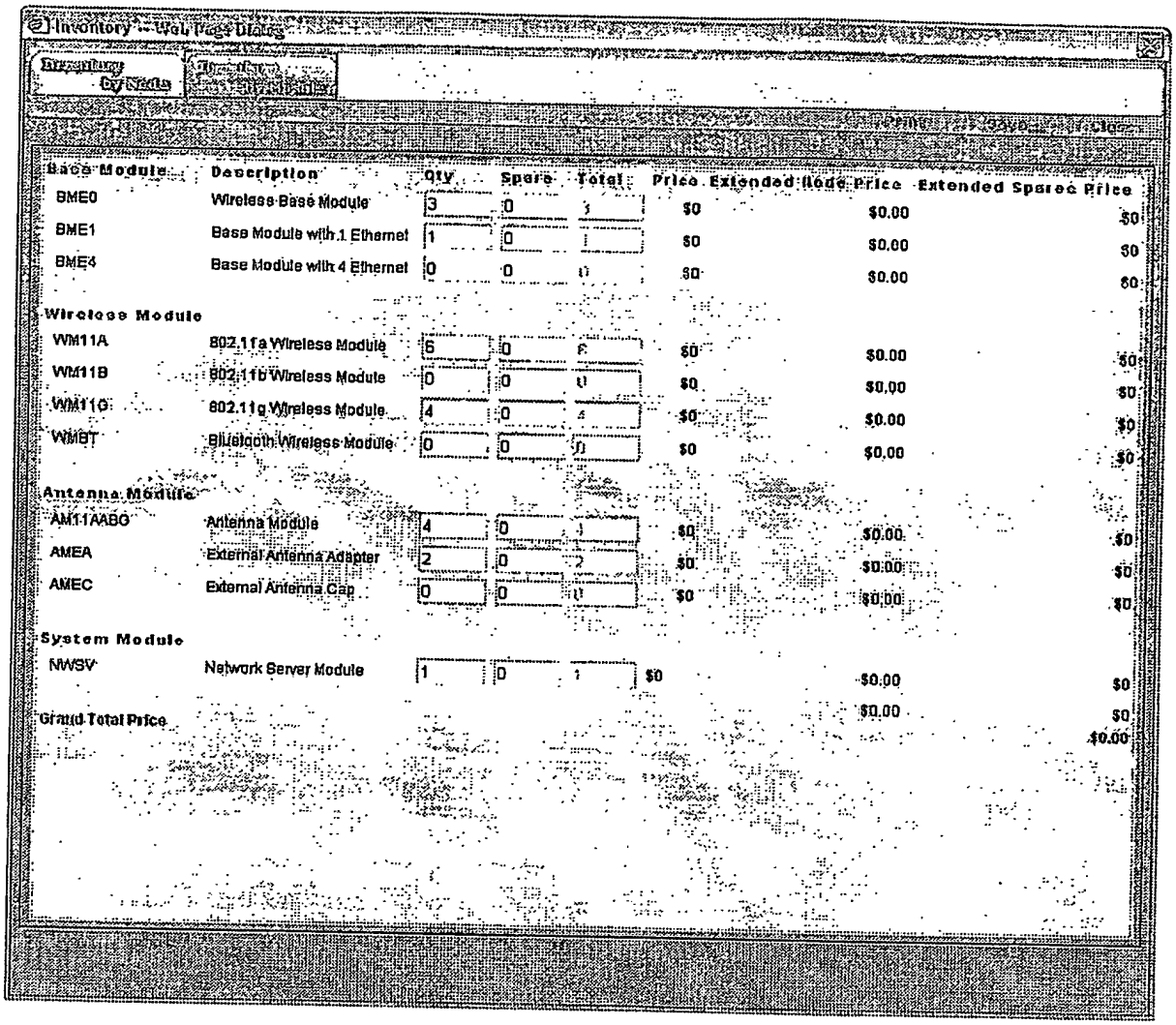


FIG. 7

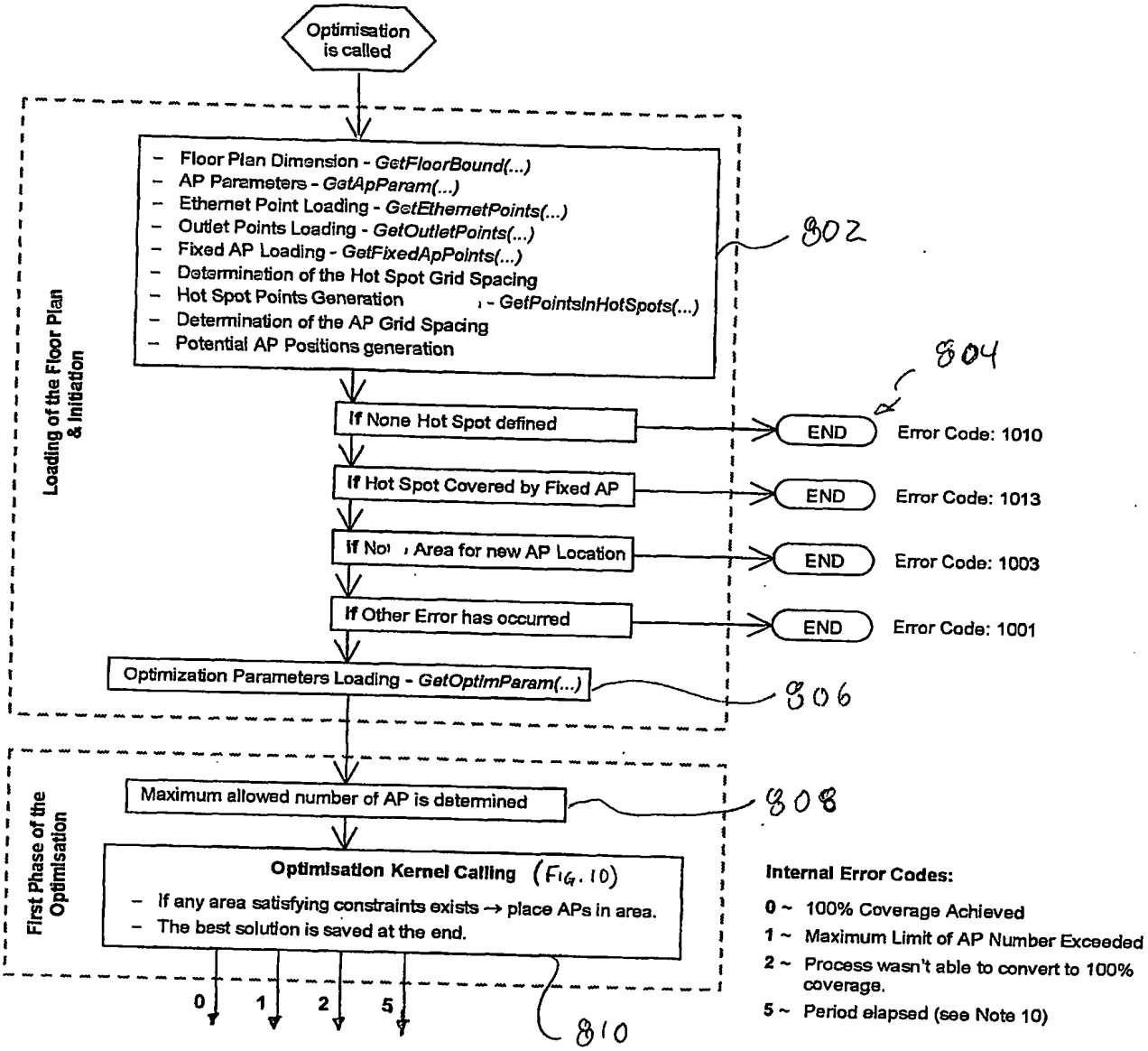

Optimisation is called
Loading of the Floor Plan & Initiation
– Floor Plan Dimension - GetFloorBound(...)
– AP Parameters - GetApParam(...)
– Ethernet Point Loading - GetEthernetPoints(...)
– Outlet Points Loading - GetOutletPoints(...)
– Fixed AP Loading - GetFixedApPoints(...)
– Determination of the Hot Spot Grid Spacing
– Hot Spot Points Generation - GetPointsInHotSpots(...)
– Determination of the AP Grid Spacing
– Potential AP Positions generation
802
804
If None Hot Spot defined
END
Error Code: 1010
If Hot Spot Covered by Fixed AP
END
Error Code: 1013
If No Area for new AP Location
END
Error Code: 1003
If Other Error has occurred
END
Error Code: 1001
Optimization Parameters Loading - GetOptimParam(...)
806
First Phase of the Optimisation
Maximum allowed number of AP is determined
808
Optimisation Kernel Calling (Fig. 10)
– If any area satisfying constraints exists → place APs in area.
– The best solution is saved at the end.
0
1
2
5
810
Internal Error Codes:
0 ~ 100% Coverage Achieved
1 ~ Maximum Limit of AP Number Exceeded
2 ~ Process wasn't able to convert to 100% coverage.
5 ~ Period elapsed (see Note 10)

FIG 8A

800

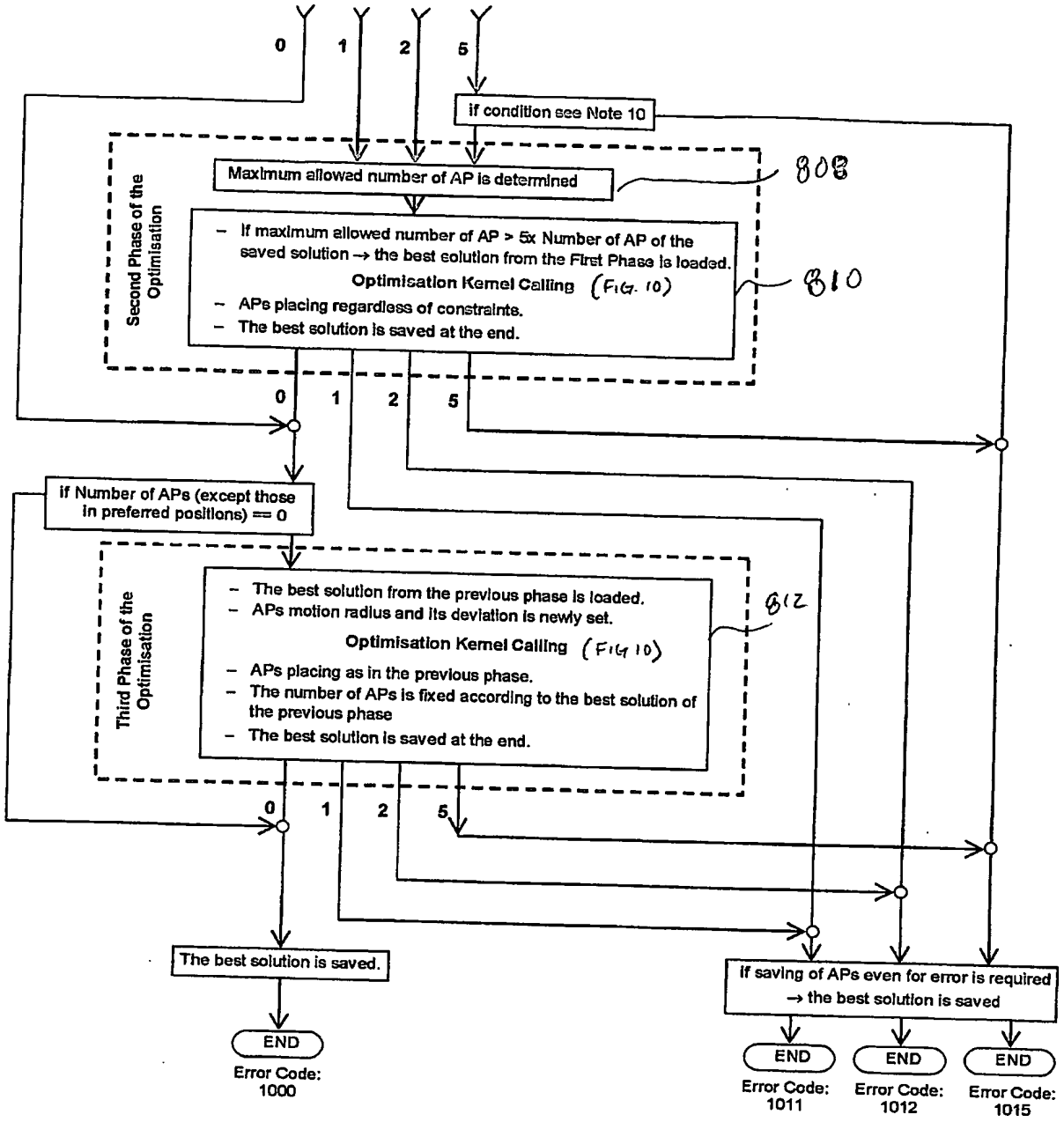

0
1
2
5
if condition see Note 10
Second Phase of the Optimisation
Maximum allowed number of AP is determined
808
- If maximum allowed number of AP > 5x Number of AP of the saved solution → the best solution from the First Phase is loaded.
Optimisation Kernel Calling (FIG. 10)
- APs placing regardless of constraints.
- The best solution is saved at the end.
810
0
1
2
5
if Number of APs (except those in preferred positions) == 0
Third Phase of the Optimisation
- The best solution from the previous phase is loaded.
- APs motion radius and its deviation is newly set.
Optimisation Kernel Calling (FIG 10)
- APs placing as in the previous phase.
- The number of APs is fixed according to the best solution of the previous phase
- The best solution is saved at the end.
812
0
1
2
5
The best solution is saved.
END
Error Code: 1000
If saving of APs even for error is required → the best solution is saved
END
Error Code: 1011
END
Error Code: 1012
END
Error Code: 1015

FIG. 8B

800

802.11A

	Radius	Area	Correction 30%
9 Mbps:	165	85,530	25,659
12 Mbps:	157	77,437	23,231
18 Mbps:	149	69,746	20,924
24 Mbps:	132	54,739	16,422
36 Mbps:	115	41,548	12,464
48 Mbps:	99	30,791	9,237
54 Mbps:	82	21,124	6,337
108 Mbps:	60	11,310	3,393
	30	2,827	848

802.11G

	Radius	Area	Correction 35%
6 Mbps:	165	85,530	29,935
9 Mbps:	157	77,437	27,103
12 Mbps:	149	69,746	24,411
18 Mbps:	132	54,739	19,159
24 Mbps:	115	41,548	14,542
36 Mbps:	99	30,791	10,777
48 Mbps:	82	21,124	7,393
54 Mbps:	60	11,310	3,958
108 Mbps:	30	2,827	990

802.11B

	Radius	Area	Correction 30%
1 Mbps:	300	282,743	84,823
2 Mbps:	252	199,504	59,851
5.5 Mbps	185	107,521	32,256
11 Mbps	154	74,506	22,352

Bluetooth

	radius	Area	Correction 30%
1 Mbps	15	707	212

FIG. 9A

	BitRate	Max Throughput
802.11b	11 Mbps	5.9 Mbps
802.11g (with 11b)	54 Mbps	14.4 Mbps
802.11g (11g-only mode)	54 Mbps	24.4 Mbps
802.11a	54 Mbps	24.4 Mbps
802.11a TURBO	108 Mbps	42.9 Mbps
Bluetooth	1 Mbps	400 Kbps

	BitRate	Receive sensitivity
802.11A	6 Mbps	-85 dBm
	9 Mbps	-84 dBm
	12 Mbps	-83 dBm
	18 Mbps	-81 dBm
	24 Mbps	-77 dBm
	36 Mbps	-74 dBm
	48 Mbps	-69 dBm
	54 Mbps	-68 dBm
	108 Mbps	-65 dBm
802.11B	1 Mbps	-94 dBm
	2 Mbps	-93 dBm
	5.5 Mbps	-92 dBm
	11 Mbps	-91 dBm
Bluetooth	1 Mbps (Green)	-50 dBm
	1 Mbps (Yellow)	-70 dBm
	1 Mbps (red)	-80 dbm

	BitRate	Receive sensitivity
802.11G	6 Mbps	-87 dBm
	9 Mbps	-85 dBm
	12 Mbps	-84 dBm
	18 Mbps	-82 dBm
	24 Mbps	-78 dBm
	36 Mbps	-75 dBm
	48 Mbps	-69 dBm
	54 Mbps	-68 dBm

FIG. 9B

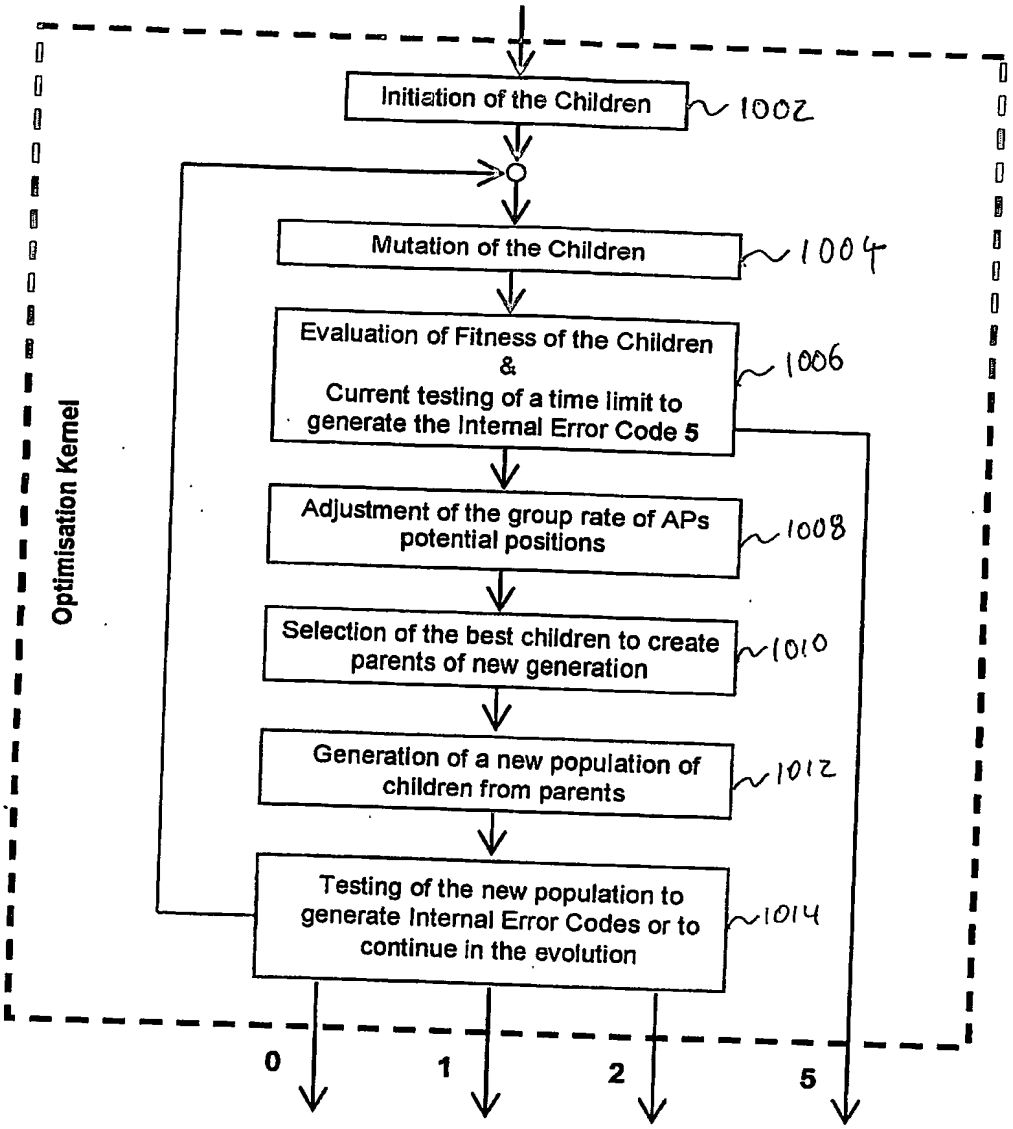

Optimisation Kernel
Initiation of the Children
1002
Mutation of the Children
1004
Evaluation of Fitness of the Children
&
Current testing of a time limit to generate the Internal Error Code 5
1006
Adjustment of the group rate of APs potential positions
1008
Selection of the best children to create parents of new generation
1010
Generation of a new population of children from parents
1012
Testing of the new population to generate Internal Error Codes or to continue in the evolution
1014
0
1
2
5

FIG. 10

1000

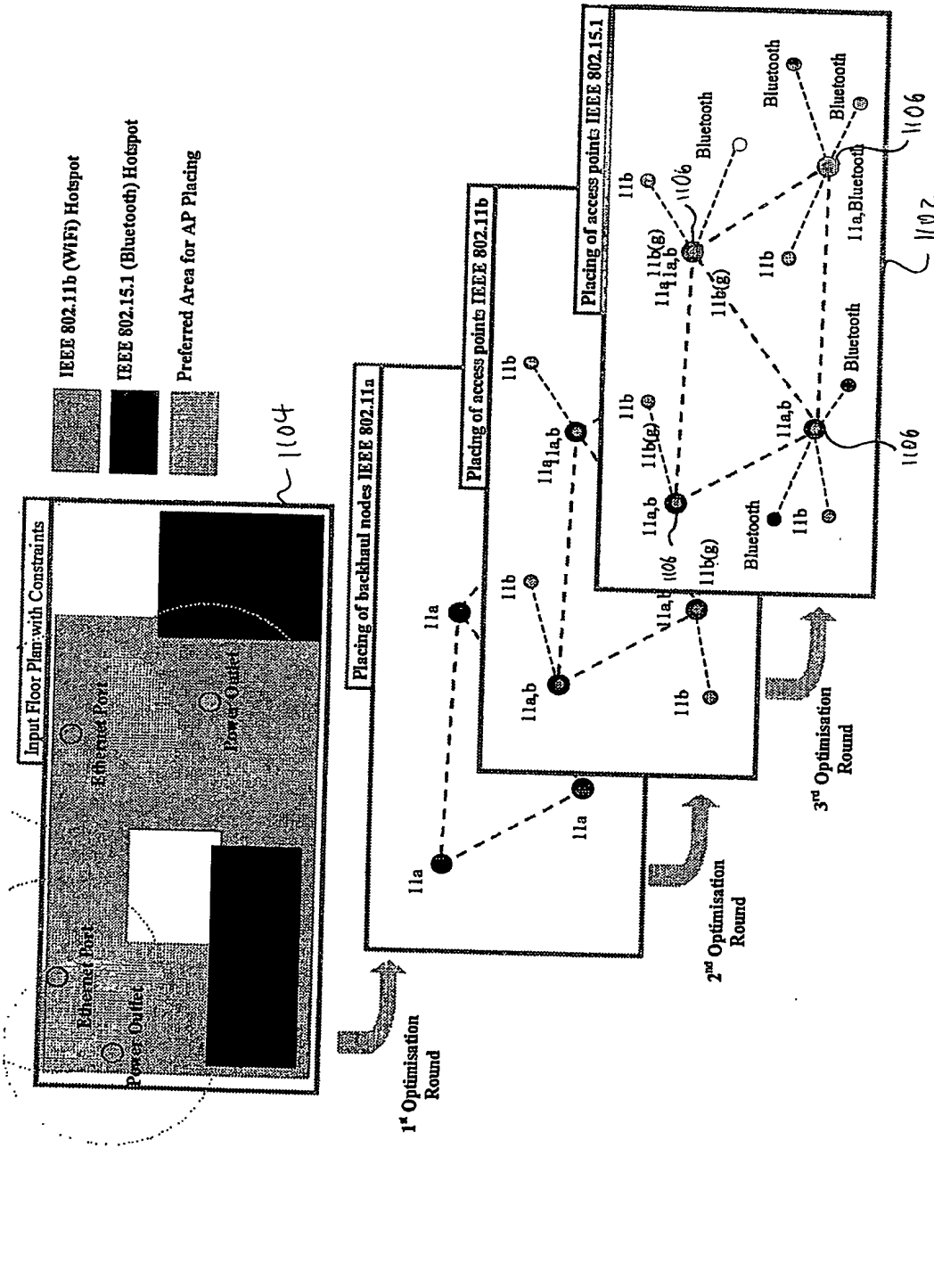

IEEE 802.11b (WiFi) Hotspot
IEEE 802.15.1 (Bluetooth) Hotspot
Preferred Area for AP Placing
Input Floor Plan with Constraints
Ethernet Port
Power Outlet
Low or Outlet
1104
Placing of backhaul nodes IEEE 802.11a
Placing of access points IEEE 802.11b
Placing of access points IEEE 802.15.1
1st Optimisation Round
2nd Optimisation Round
3rd Optimisation Round
11a
11b
11a,b
11b(g)
Bluetooth
1106
1102

FIG. 11

Structure of Chromosome: **Evolution strives for**

Fixed Part

Number of AP in preferred position,	N_p	Minimal number
Number of freely placed AP	N	Minimal number
Rate of new AP revival	r_N	Zero

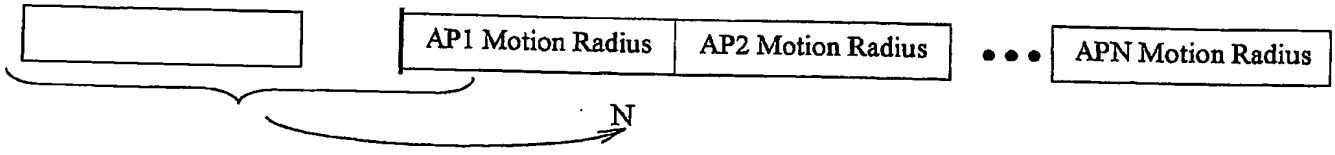
Variable Parts

AP in preferred pos. 1:	Position	x, y	Optimal values
	Power	P_N	Optimal value
AP in preferred pos. N_p:	Position	x, y	Optimal values
	Power	P_N	Optimal value
Freely placed AP. 1:	Motion radius	R_m	Zero
	Position	x, y	Optimal values
	Power	P_N	Optimal value
Freely placed AP N:	Motion radius	R_m	Zero
	Position	x, y	Optimal values
	Power	P_N	Optimal value

Note: symbols *N, r, P, R* are mutating variables during the evolution

Number of APs

Number of APs



variable length of chromosome

FIG 12

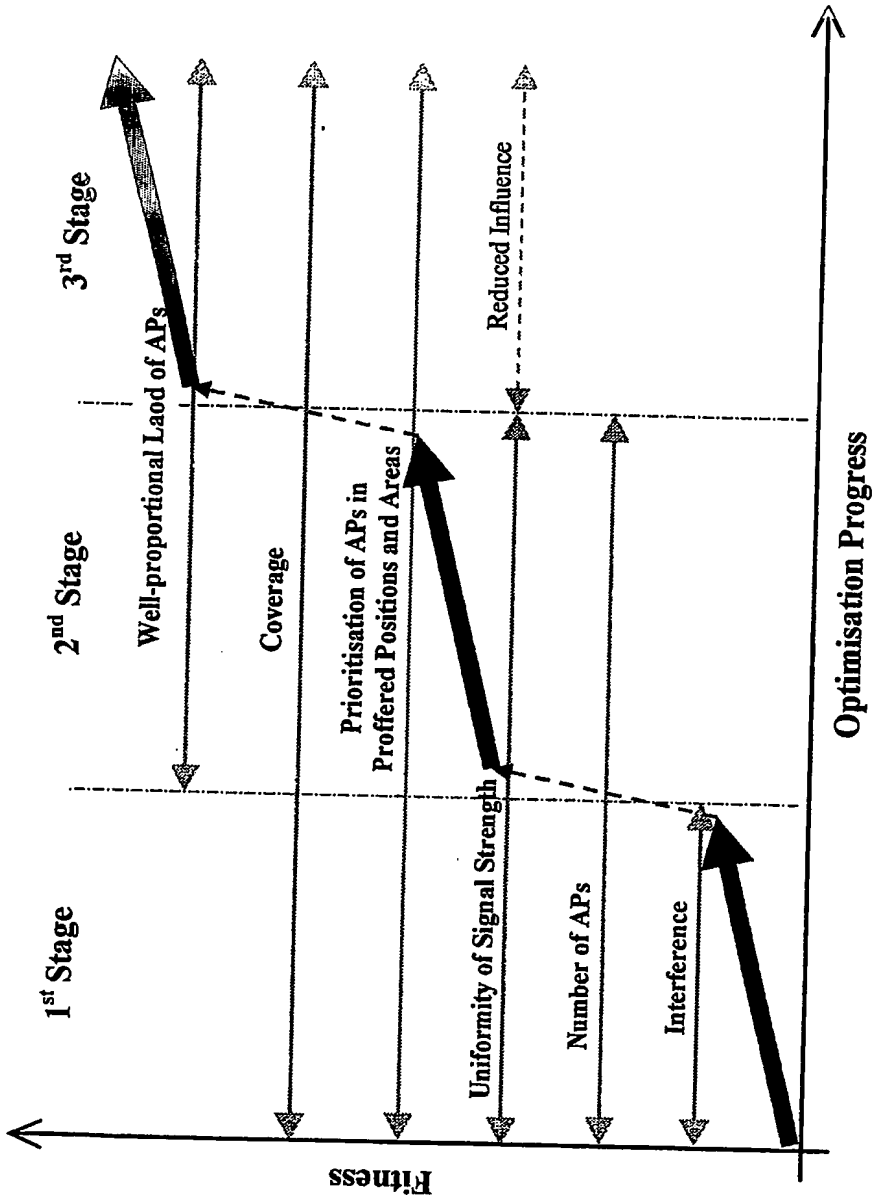

Optimisation Progress
Fitness
1st Stage
2nd Stage
3rd Stage
Well-proportional Laod of APs
Coverage
Prioritisation of APs in Proffered Positions and Areas
Reduced Influence
Uniformity of Signal Strength
Number of APs
Interference

FIG. 13